APPLICATION FOR UNITED STATES LETTERS PATENT

of

Thomas S. Neal
858 Hyde Avenue
Cupertino, CA 95015

Guillermo Andres
5132 Orsini Ct.
Pleasanton, CA 94588

John Norman
1450 Bing Drive
San Jose, CA 95129-4705

Ray Gradwohl
17790 McKinnon Drive
Saratoga, CA 95070

for

KEYBOARD WITH A SWITCH-MEMBRANE ASSEMBLY CIRCUIT-NODE SUPPORT LOCATED IN CAVITY

IP Administration
Legal Department, M/S 35
HEWLETT-PACKARD COMPANY
P.O. Box 272400
Fort Collins, CO 80527-2400

File No. 200314054-1

Certificate of Mailing Under 37 C.F.R. § 1.10

Express Mail Label No. EF394245935US Date of Deposit: March 12, 2004
I hereby certify that this paper or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 C.F.R. § 1.10 on the date indicated above and is addressed to: MS PATENT APPLICATION, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Signature

KEYBOARD WITH A SWITCH-MEMBRANE ASSEMBLY CIRCUIT-NODE SUPPORT LOCATED IN A CAVITY

CROSS-REFERENCED APPLICATIONS

[1] U.S. Design Patent Application serial number ....., titled PANEL AND SPECIAL FUNCTION KEYS FOR KEYBOARD OR SIMILAR ARTICLE, attorney docket number 200314059-1 (1964-44-5), filed on 12 March 2004, is herein incorporated by reference.

BACKGROUND

[2] Many computer systems include a processor that receives data and executes instructions, and a keyboard that is coupled to the processor and that allows one to provide data to the processor. The keyboard typically includes many circuits that, when closed individually or in combination with another circuit, generate a respective signal that provides the processor corresponding data. To close a circuit, one typically exerts pressure on a respective key of the keyboard.

[3] **FIG. 1** is an exploded view of a conventional keyboard ***10***, which includes a plurality of circuits ***12*** (only two reference numbers denoting one circuit shown for clarity) and a plate ***14*** to support the circuits when one or more of circuits are closed. The keyboard ***10*** also includes a plurality of keys ***16*** (only two shown for clarity) each corresponding to a respective circuit ***12***, an upper enclosure ***18*** to hold each key ***16*** and protect components inside the keyboard, and a lower enclosure ***20*** to support and protect components inside the keyboard. The lower enclosure ***20*** includes a cavity ***21*** for stiffening the lower enclosure and providing a passage for the cable ***23*** that couples the keyboard ***10*** to a processor (not shown). The keyboard ***10*** also includes a switch-membrane assembly ***22*** that includes the circuits ***12***. The switch-membrane assembly ***22*** includes a top sheet ***24*** having top portions ***26*** and top nodes ***28*** of each circuit ***12,*** a bottom sheet ***30*** having bottom portions ***32*** and bottom nodes ***34*** of each circuit, and an insulating sheet ***36*** between the top and bottom sheets for insulating the top circuit portions from the

bottom circuit portions. The insulating sheet ***36*** also includes a plurality of holes ***38*** (only one reference number shown for clarity), each corresponding to a respective set of nodes ***28*** and ***34*** for each circuit ***12***. The keyboard ***10*** also includes a plurality of elastic domes ***40*** (only one reference number shown for clarity), each corresponding to a respective key ***16*** to urge the key away from the switch-membrane assembly ***22***.

[4] To close a circuit ***12*** of the switch-membrane assembly ***22***, one presses a corresponding key ***16*** to couple the top portion ***28*** of the circuit with the bottom portion ***32*** by causing the top node ***28*** to contact the bottom node ***34***. That is, to contact the top node ***28*** with the bottom node ***34***, one exerts pressure on the key ***16***, and thus the corresponding dome ***40,*** to move the top node ***28*** through the hole ***38*** toward the bottom node ***34***. The plate ***14*** supports the bottom node ***34*** to help establish contact between the top node ***28*** and bottom node when the top node is moved through the hole ***38***. The support function of the plate ***14*** is especially important if the bottom node ***34*** is located above the cavity ***21***. Without some support, the bottom node ***34*** would move into the cavity ***21*** when the top node ***28*** is moved toward it, and thus the top node may not contact the bottom node to generate a signal. To re-open the circuit ***12***, one removes the pressure exerted on the key ***16*** to allow the elastic dome ***40*** to urge the key ***16*** away from the top node ***28***, and thus allow the top node to move away from and out of contact with the bottom node ***34***.

[5] Unfortunately, manufacturing the keyboard ***10*** can be complex and expensive. The plate ***14*** is typically made of metal and sized to match the area of the switch-membrane assembly ***22*** to provide the keyboard ***10*** a desired stiffness during use. In addition, the plate ***14*** must be located in the keyboard ***10*** to complete the keyboard's assembly. Consequently, the cost to manufacture the keyboard ***10*** includes the cost of the labor and material used to make the plate ***14*** and the cost of the labor used to install the plate in the keyboard.

SUMMARY

[6] In one aspect of the invention, a keyboard enclosure includes a region forming a cavity to stiffen the lower enclosure and a node support located in the cavity to support a node of a circuit in a switch-membrane assembly of the keyboard. With the node support, a plate to support the switch-membrane assembly may be omitted from the keyboard. Thus, the keyboard may be easier and less expensive to manufacture than a conventional keyboard.

BRIEF DESCRIPTION OF THE FIGURES

[7] **FIG. 1** is an exploded view of a conventional keyboard.

[8] **FIG. 2** is an exploded view of a keyboard incorporating a lower enclosure according to an embodiment of the invention.

[9] **FIG. 3** is a plan view of the lower enclosure of **FIG. 2**.

[10] **FIG. 4** is a side view of the keyboard of **FIG. 2**.

[11] **FIG. 5** is a block diagram of an electronic system that includes the keyboard of **FIGS. 2 and 4**.

Detailed Description

[12] **FIG. 2** is an exploded view of a keyboard ***50*** that includes a lower enclosure ***52*** having node supports ***54***, according to an embodiment of the invention. The keyboard ***50*** may be used to provide data to a processor (not shown) for performing various computing functions, such as executing programs to perform specific tasks. Each node support ***54*** supports a respective circuit node ***56*** that is located above a cavity ***58*** formed in the lower enclosure ***52***. Each circuit node ***56*** is a component of a respective one of a plurality of circuits ***60*** (only four reference numbers shown for clarity) in the keyboard ***50*** that may generate a signal

to provide the processor data as discussed below. Because the node support ***54*** can support the circuit nodes ***56***, the keyboard ***50*** does not require a plate (e.g., ***14*** in **FIG. 1**) to support the circuit nodes located above the cavity ***58***.

[13] The keyboard ***50*** also includes a plurality of keys ***62*** (only one shown for clarity), each corresponding to a respective circuit ***60***, and an upper enclosure ***64*** that includes a plurality of key receptacles ***66*** (only one reference number shown for clarity) each to hold a respective key ***62***. The keyboard ***50*** also includes a switch-membrane assembly ***68*** that includes the plurality of circuits ***60***. The switch-membrane assembly ***68*** includes a top sheet ***70*** having a top portion ***72*** and a top node ***74*** of each circuit ***60***, a bottom sheet ***76*** having a bottom portion ***78*** and a bottom node ***56*** of each circuit ***60***, and an insulating sheet ***80*** between the top and bottom portions. The insulating sheet ***80*** also includes holes ***82*** (only one reference number shown for clarity), each corresponding to a respective set of top and bottom nodes for each circuit ***60***. The keyboard ***50*** also includes a plurality of elastic domes ***84*** (only one reference number shown for clarity), each corresponding to a respective key ***62*** and operable to bias the key ***62*** away from the switch-membrane assembly ***68***.

[14] In operation, when one presses a key ***60,*** the corresponding circuit ***60*** in the keyboard ***50*** generates a respective signal to provide the corresponding data (e.g., an ASCII character such as "A") to the processor (not shown). That is, when a circuit ***60*** is closed, it generates a signal, and when a circuit ***60*** is open, it does not generate a signal. To close a circuit ***60***, one exerts pressure on the key ***62*** that corresponds to the circuit to contact the circuit's respective bottom node ***56*** with the top node ***74***. If the bottom node ***56*** is located above the cavity ***58***, then a respective node support ***54*** supports the bottom node to help ensure contact between the top and bottom nodes ***74*** and ***56***, respectively, is maintained while the circuit ***60*** generates the signal. If the bottom node ***56*** of the circuit is not located above the cavity ***58***, then the floor ***86*** of the lower enclosure ***52*** may support the bottom node ***56*** while the circuit ***60*** generates the signal. To open the circuit ***60***, one removes the pressure from the key ***62*** to allow a respective elastic dome ***84*** to move the key away from the switch membrane ***68***, and thus, the top node ***74***

moves away from the bottom node ***56*** to break the contact between the top and bottom nodes.

[15] **FIG. 3** is a top view of the lower enclosure ***52*** in **FIG. 2**. The lower enclosure ***52*** includes a region ***90*** that forms the cavity ***58*** and that stiffens the lower enclosure, and node supports ***54*** disposed in the cavity to support the bottom nodes ***56*** (**FIG. 2**) that are located above the cavity. Although **FIG. 3**. shows the lower enclosure ***52*** including one region ***90*** that forms a cavity ***58***, the lower enclosure may include two or more regions ***90*** as desired to stiffen the lower enclosure and/or to provide node supports ***54*** for corresponding bottom nodes ***56*** or to provide room for other components (not shown) of the keyboard ***50*** (**FIG. 2**). Furthermore, the region ***90*** of the lower enclosure ***52*** may include two or more cavities ***58*** as desired to stiffen the lower enclosure, or to provide node supports ***54*** for corresponding bottom nodes ***56***, or to provide room for other components of the keyboard ***50***.

[16] The cavity ***58*** may have any desired shape. For example, in one embodiment the cavity ***58*** may have a substantially U-shaped cross-section. In another embodiment, the cavity ***58*** extends approximately 15.5 inches across the floor ***86*** of the lower enclosure ***52*** and includes a bottom wall ***92*** and a sidewall ***94***. In this embodiment, the sidewall ***94*** extends approximately 0.5 inches between the floor ***86*** and the bottom wall ***92***, and thus provides an approximate cavity depth of 0.5 inches.

[17] Other embodiments are contemplated. For example, the cavity ***58*** may have a substantially W-shaped cross-section and, when viewed from above may curve across the floor ***86***. For example, when viewed from above, the cavity ***58*** may form an S, a circular or elliptical arc, or any other such curve.

[18] Still referring to **FIG. 3**, the lower enclosure ***52*** may include any number of node supports ***54***, and each node support may be located anywhere in the cavity ***58*** to correspond to a respective circuit node ***56*** (**FIG. 2**) that is located above the cavity. Furthermore, each node support ***54*** may be shaped as desired to

support the circuit node ***56***. For example, in one embodiment the lower enclosure ***52*** may include thirteen node supports ***54*** and each node support ***54*** may be cylindrically shaped and hollow. Each node support ***54*** may also extend from the bottom wall ***92*** toward the floor ***86*** of the lower enclosure ***52***, and include an end ***96*** that is substantially level with the floor ***86***. Thus, the bottom sheet ***76*** (**FIG. 2**) typically lies substantially flat when supported by the lower enclosure ***52***, and remains substantially flat when the key ***62*** (**FIG. 1**) urges a top node ***74*** (**FIG. 1**) to contact a bottom node ***56*** that is located above the cavity ***58***.

[19] Other embodiments are contemplated. For example, the lower enclosure ***52*** may include more or fewer node supports ***54***, and one or more of the node supports ***54*** may be square shaped, solid and extend from a sidewall ***94*** of the region ***90***. Furthermore, one or more of the node supports ***54*** may extend from the bottom wall ***92*** or sidewall ***94*** to locate the end ***96*** above or below the floor ***86*** of the lower enclosure ***52***. This may be desirable when other components of the keyboard ***50*** are located between the bottom sheet ***76*** and the floor ***86***.

[20] Still referring to **FIG. 3**, the lower enclosure may also include ribs ***98*** to support the node supports ***54*** and maintain the position of the node supports ***54*** relative to the floor ***86***. Each rib ***98*** may extend from a node support ***54*** toward another node support ***54*** and/or the bottom wall ***92*** and/or the sidewall ***94***. For example, in one embodiment four ribs ***98*** may support one of the node supports ***54*** (see ***A*** in **FIG. 3**). Two of the ribs ***98*** may extend between the sidewall ***94***, the bottom wall ***92*** and the node support ***54***; and the other two ribs ***98*** may extend between the node support ***54***, adjacent node supports ***54***, and the bottom wall ***92***. Another node support ***54*** (see ***B*** in **FIG. 3**) may be supported by four ribs ***98*** with one of the ribs ***98*** extending between the bottom wall ***92*** and the node support ***54***; not the sidewall ***94*** or other node supports ***54***. And yet another node support ***54*** (see ***C*** in **FIG. 3**) may be supported by two ribs ***98*** with one of the ribs ***98*** extending between the node support ***54***, the bottom wall ***92*** and the sidewall ***94***, and the other rib ***98*** extending between the node support ***54***, an adjacent node support ***54*** and the bottom wall ***92***.

[21] Still referring to **FIG. 3**, the lower enclosure ***52*** may be made from any desirable material using any desired manufacturing process. For example, in one embodiment the lower enclosure ***52*** may be made of conventional plastic and cast as one piece from a mold. Thus, the node supports ***54*** and ribs ***98*** may be an integral part of the formed lower enclosure ***52***. In other embodiments, the node supports ***54*** and ribs ***98*** may be fastened to the lower enclosure ***52*** using any desired means, such as gluing with an adhesive.

[22] **FIG. 4** is a side view of the keyboard in **FIG. 2** assembled and positioned on a surface ***100***, according to an embodiment of the invention. When the keyboard ***50*** is assembled, the upper enclosure ***64*** may be mounted to the lower enclosure ***52*** to protect the switch-membrane assembly ***68*** (**FIG. 2**), elastic domes ***84*** (**FIG.**2) and other components of the keyboard ***50*** that may be located between the upper and lower enclosures ***64*** and ***52***, respectively. To position the keyboard ***50*** on the surface ***100*** as shown, the lower enclosure ***52*** may include a leg ***102*** that may be extended from the region ***90***. For example, in one embodiment the leg ***102*** may contact the surface ***100*** at a substantially perpendicular angle. Furthermore, the region ***90*** may be formed to position the bottom wall ***92*** substantially parallel to the surface ***100*** when the keyboard ***50*** is positioned as shown. Thus, each node support ***54*** may be angled relative to the bottom wall ***92*** so that each node support's end ***96*** (**FIG. 3**) remains substantially parallel with the floor ***86***.

[23] **FIG. 5** is a block diagram of an electronic system ***110*** that incorporates the keyboard ***50*** (**FIGS 2** and **4**). The system ***110*** includes computer circuitry ***112***, which includes a processor ***114*** and a memory ***116*** coupled to the processor, for performing computer functions such as executing software to perform desired calculations and tasks. One or more input devices ***118*** that includes the keyboard ***50*** and may include other devices such as a mouse or microphone, are coupled to the computer circuitry ***112*** and allow an operator (not shown) to input data thereto. One or more output devices ***120*** are coupled to the computer circuitry ***112*** to provide to the operator data generated by the computer circuitry ***112***. Examples of such output devices ***120*** include a printer and a video display unit. One or more data-storage devices ***122*** are coupled to the computer circuitry ***112*** to store data on

or to retrieve data from external storage media (not shown). Examples of such storage devices ***122*** and the corresponding storage media include drives that accept hard and floppy disks, tape cassettes, and compact disk read-only memories (CD ROMS).

[24] The preceding discussion is presented to enable one skilled in the art to make and use the invention. Various modifications to the disclosed embodiments will be readily apparent to those skilled in the art, and the generic principles herein may be applied to other embodiments and applications without departing from the spirit and scope of the present invention. Thus, the present invention is not intended to be limited to the embodiments shown, but is to be accorded the widest scope consistent with the principles and features disclosed herein.